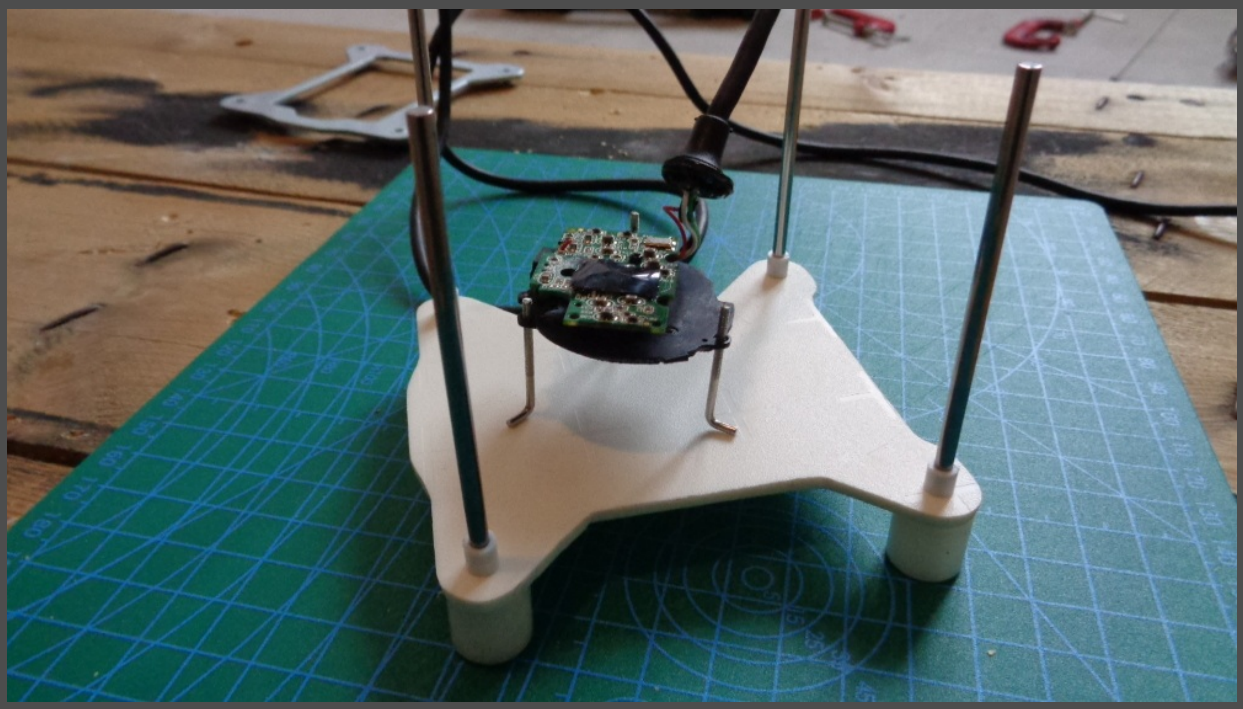
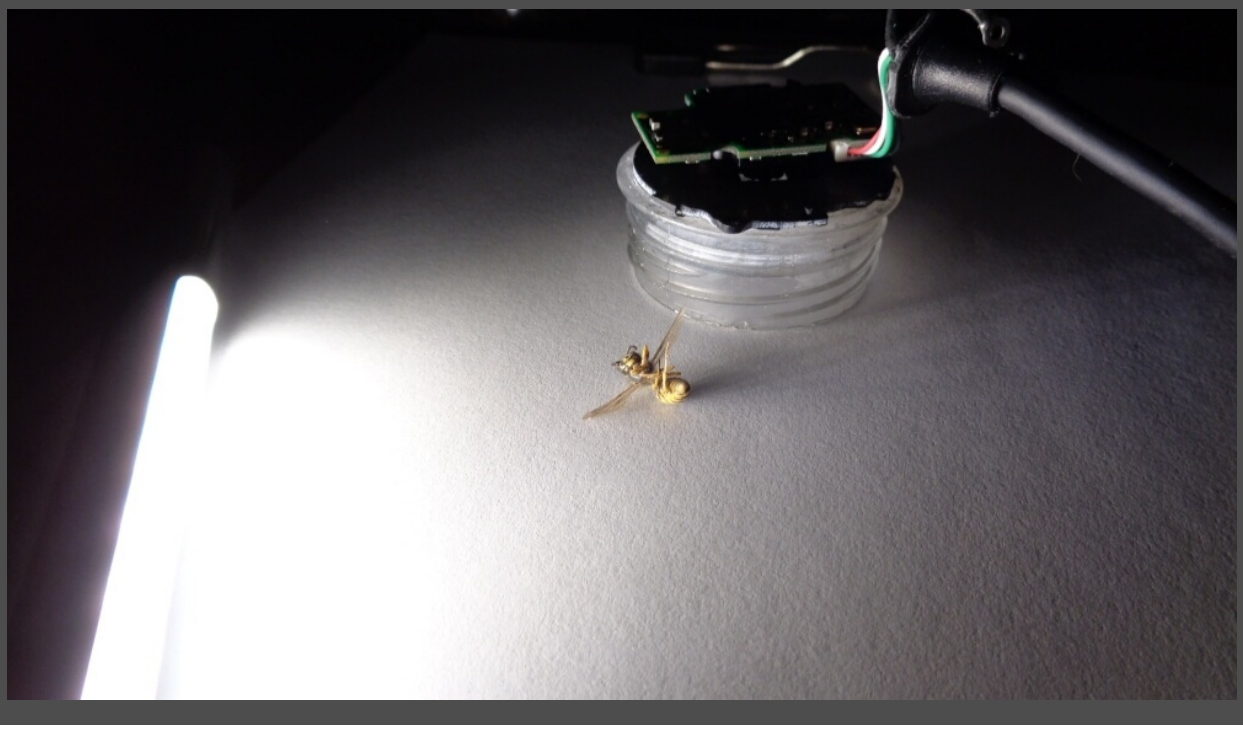


USB Microscope v2

Preface

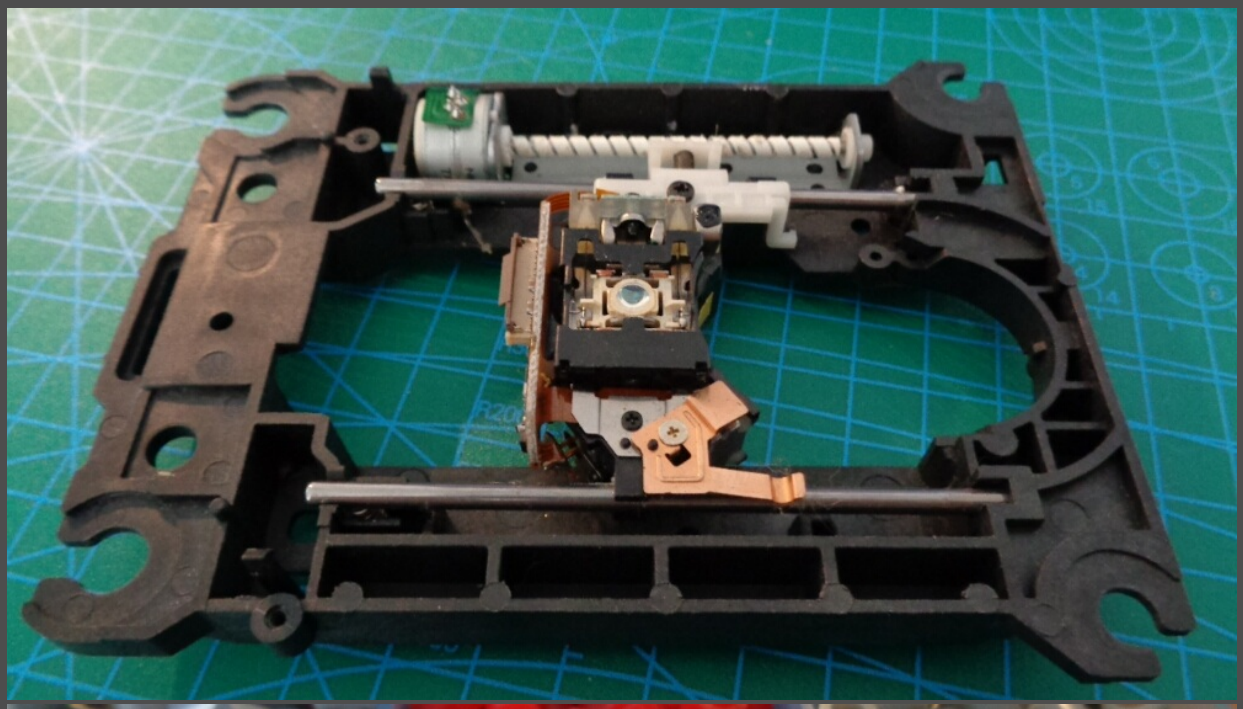
During the last weeks I used the first version of my USB Microscope several times. I noticed some details that disturbed me. For example, I could only examine objects with a certain height, because I had made the transparent plastic ring for PCBs. As you can see on the photo below, I wanted to examine a dead bee. I couldn't use the microscope with the ring because it has different planes. The ring also limited the size of the objects I could examine. After I had removed the ring, I could adjust different heights with my hand, but unfortunately it wobbled then with video recordings. Altogether I was very dissatisfied with the first version and started to implement version two. In this article I describe my approach, what kind of materials I used and which changes were introduced during the implementation of the project.

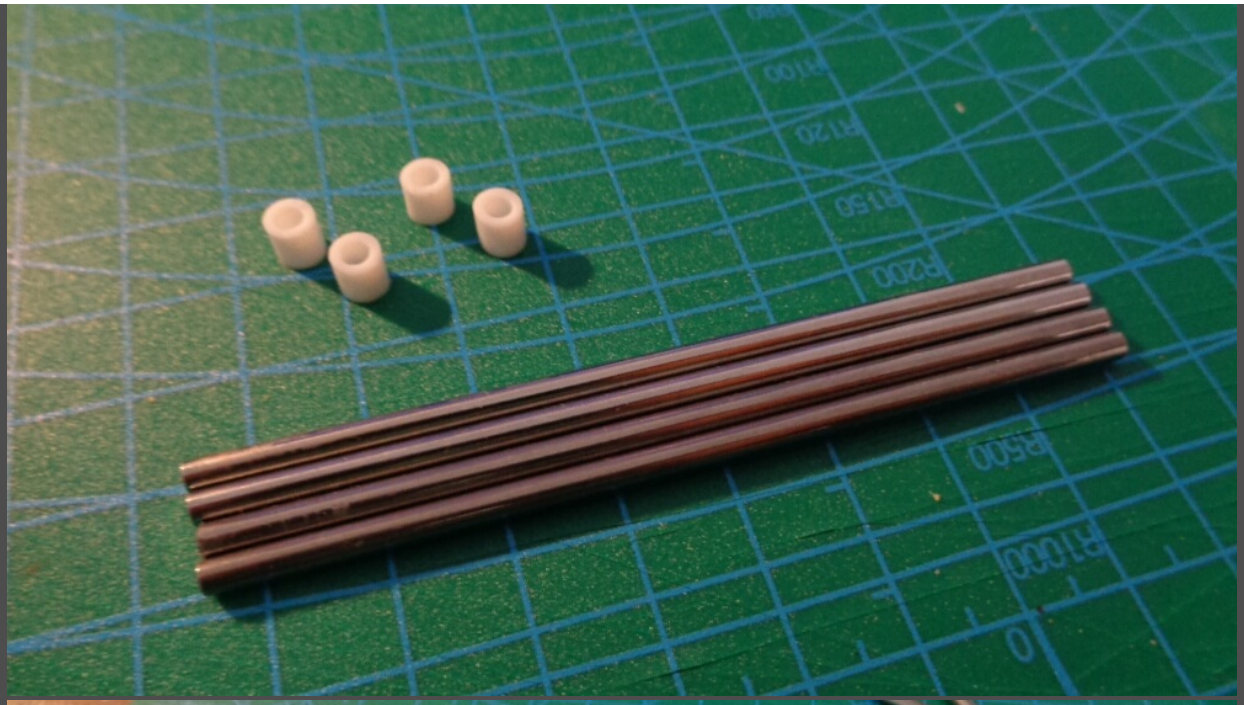
I am also concerned that the development of a prototype can be very simple. I already mentioned this topic in the first and second versions of my bed lamp. I think it's important to sensitize beginners to the fact that you can get all materials from your own household. Whether this is from an old computer or external hard disks. We all have old devices somewhere that can be recycled. Something that also bothers me a lot is that a lot of people use hot glue for their great ideas and projects. This not only looks bad in many cases, but also shows how little effort you put into it. So I'll also be showing techniques that work without superglue or hotmelt. This makes your project look much more professional.

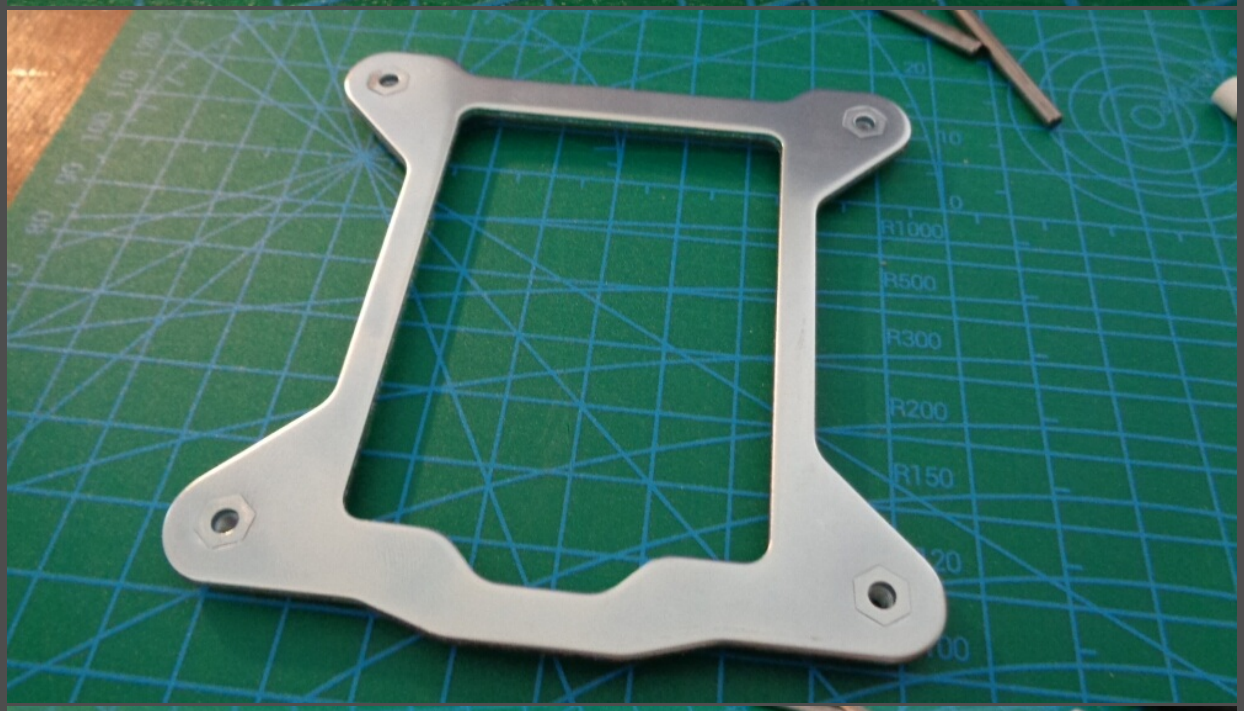


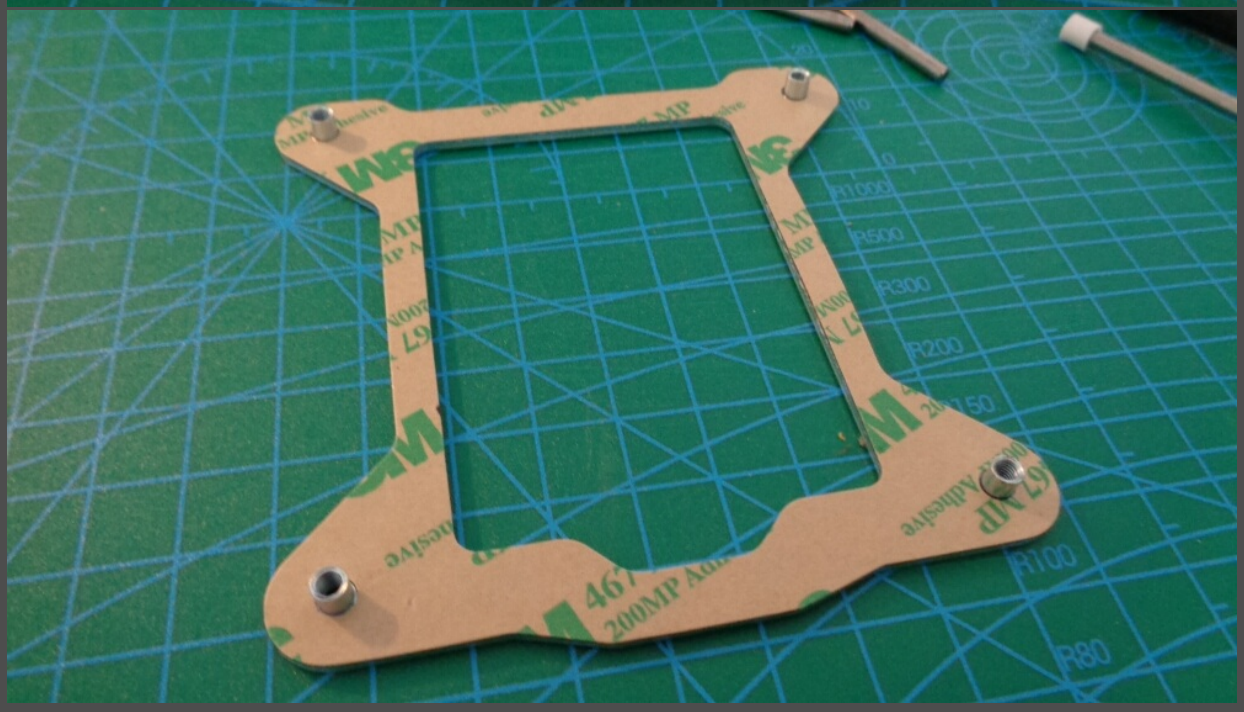
Materials

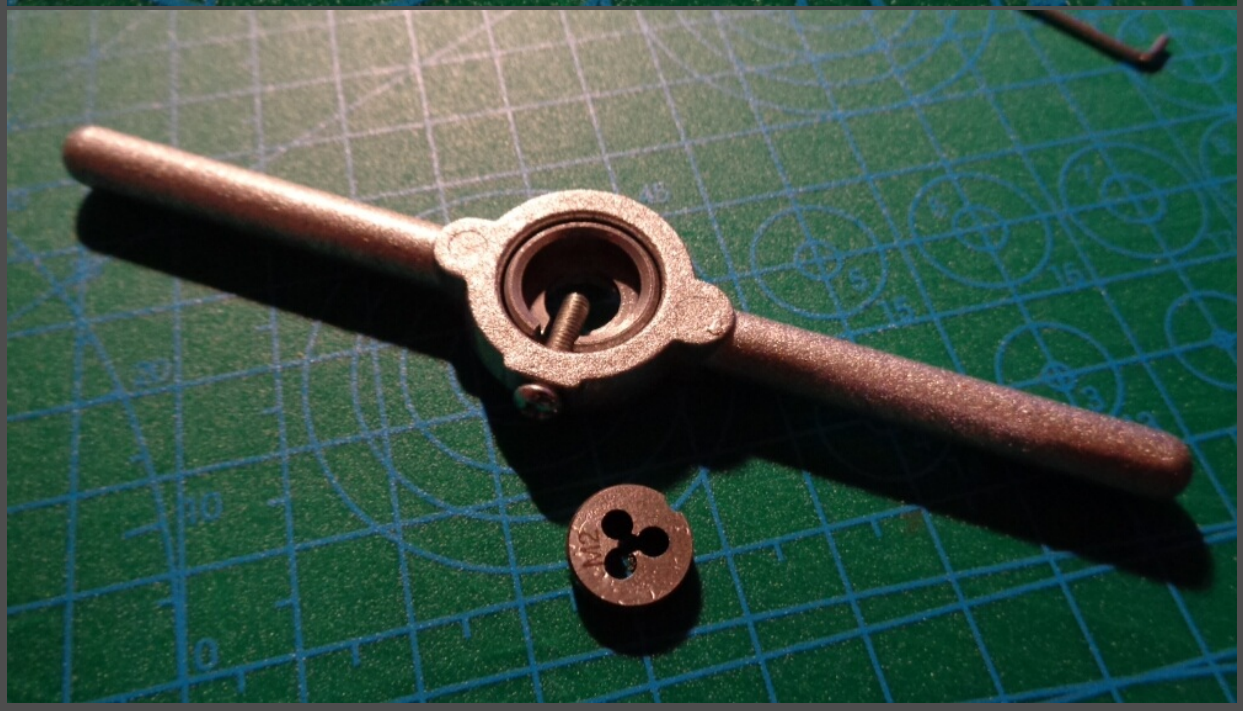
Except for the tools and the iron-on beds I didn't buy any material this time. In the year 2018 I noticed that I ordered quite a lot of materials on the internet to realize projects, but I stored everything in the warehouse. For example, I still have solar cells for the Cyberdeck, two Arduino Uno, three Raspberry Pi, and components for a complete CNC plotter. In addition people have monitors, DVBT Reciever, DVD Player and what else I know. An old german Mark VII console, half a Apple Newton MessagePad 130, an E-Reader that needs a new housing and much more. I have enough material for 40 projects and have to work on them before I buy new material. It's like my Steam account. I buy new games all the time although I haven't played through the old ones yet.











- Plastic roll (4x) from a old printer
- Metal rods (4x) from a old DVD drive (M2)
- White PVC from a broken laptop stand
- White Iron-on beds (8x)
- Metal saw
- Precision Knife
- Bent thin metal rods (3x)
- Safety eyewear
- Tap and die (M2)
- USB Micrsocope v1
- Metal scrap (from a external hard disk?)
- Digital calliper
- Parallel vice
- Coulter clamps
- Drilling machine with different wood drilling inserts
- White paper
- Pencil
- Screws with nuts (M2)
- Hammer
- Scissors

Realisation

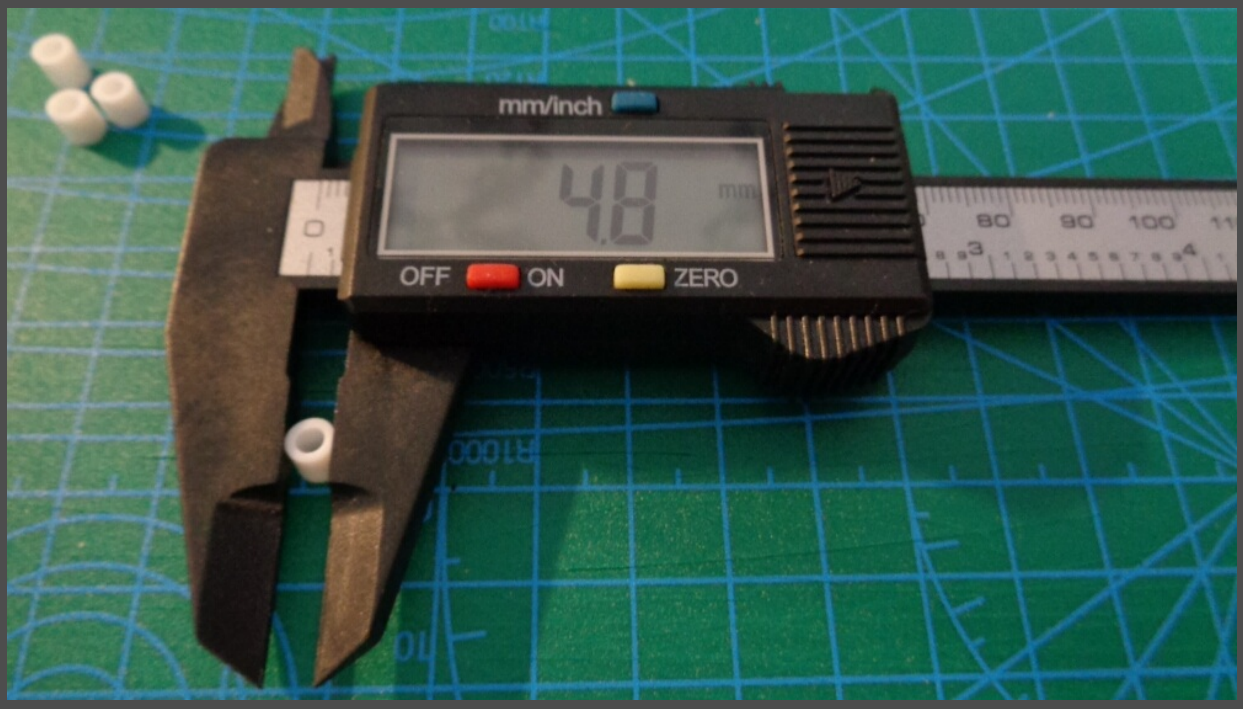
Two weeks ago I was in a 1€ shop and bought some parts and small stuff for my projects. By chance I found the iron-on beds shown above. I used them as a child in kindergarten, but didn't notice this product later. That turned out to be a mistake because you can use them for so many

applications. For example, if you want to screw a CNC shield on a wooden plate, but you don't want to put the PCB on the wood. Then you can use the iron-on beds as spacers. This is quite practical. Since I was just working on another idea, I put a white iron-on bed on a small metal rod from an old DVD drive and it fitted like a glove.

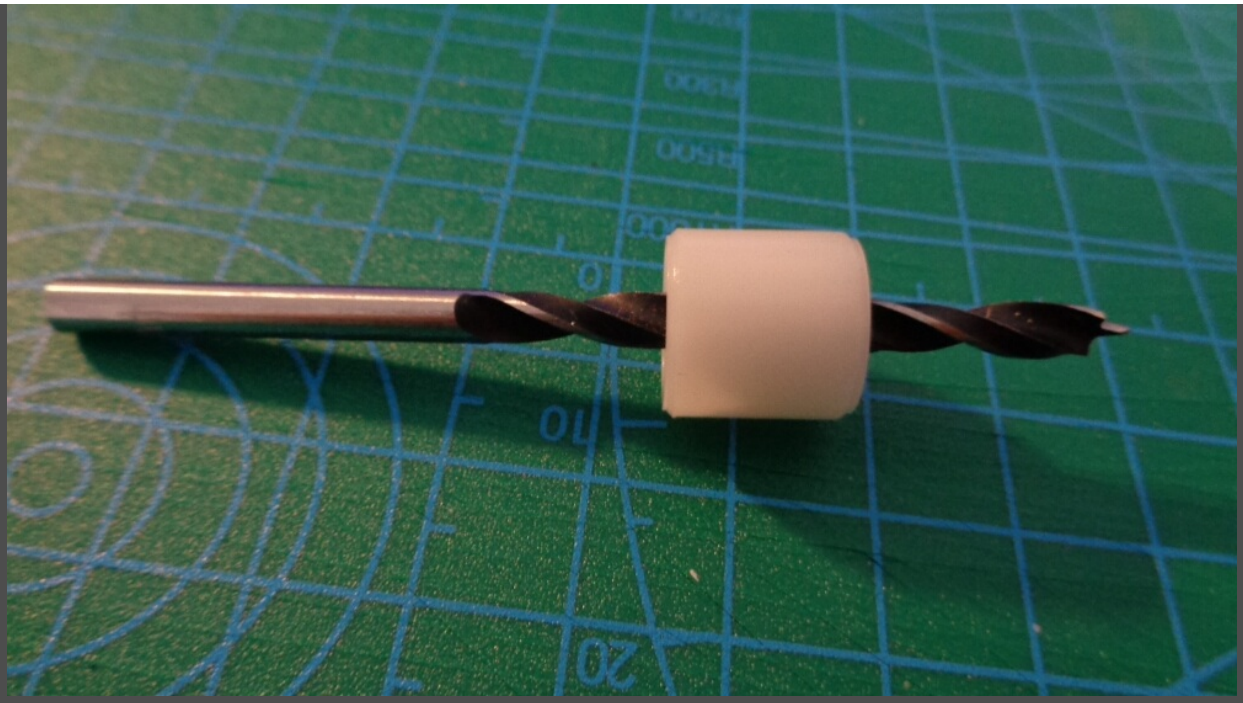
So that my USB microscope in the second version looks a little more like a professional product, I found a small metal frame. I can't remember exactly where I got it from. Maybe the frame is from an old external hard drive. From an old printer I found small white rolls that can be used as feet for the frame. These also fit perfectly. A printer is a perfect source for components, you get rollers, threaded rods, motors and a large amount of gears.

Since the wheels already fitted to the metal frame, I only had to find a solution how to put the DVD poles with the wheels together. I didn't want to use superglue or hot glue as I already mentioned above.

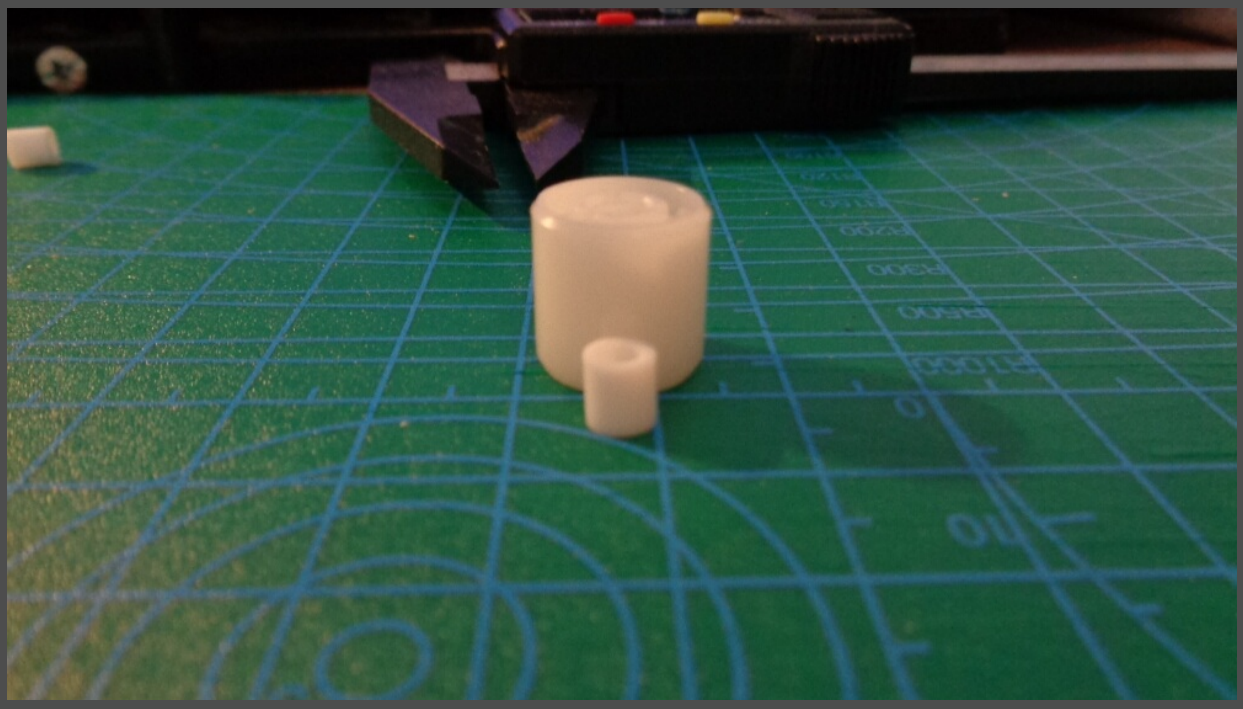
To make sure that I really like the idea with the rolls, I have equipped the frame with four pieces. I had to clean them first, because they were rubbed with grease in the old printer. For this I used a solution of glass cleaner and water.



I measured the iron-on beds with a digital caliper gauge. The outside diameter is 4.8mm. Since the components are made of a very soft plastic you can cheat a little and it is possible to get 0.1mm by warming it by hand.



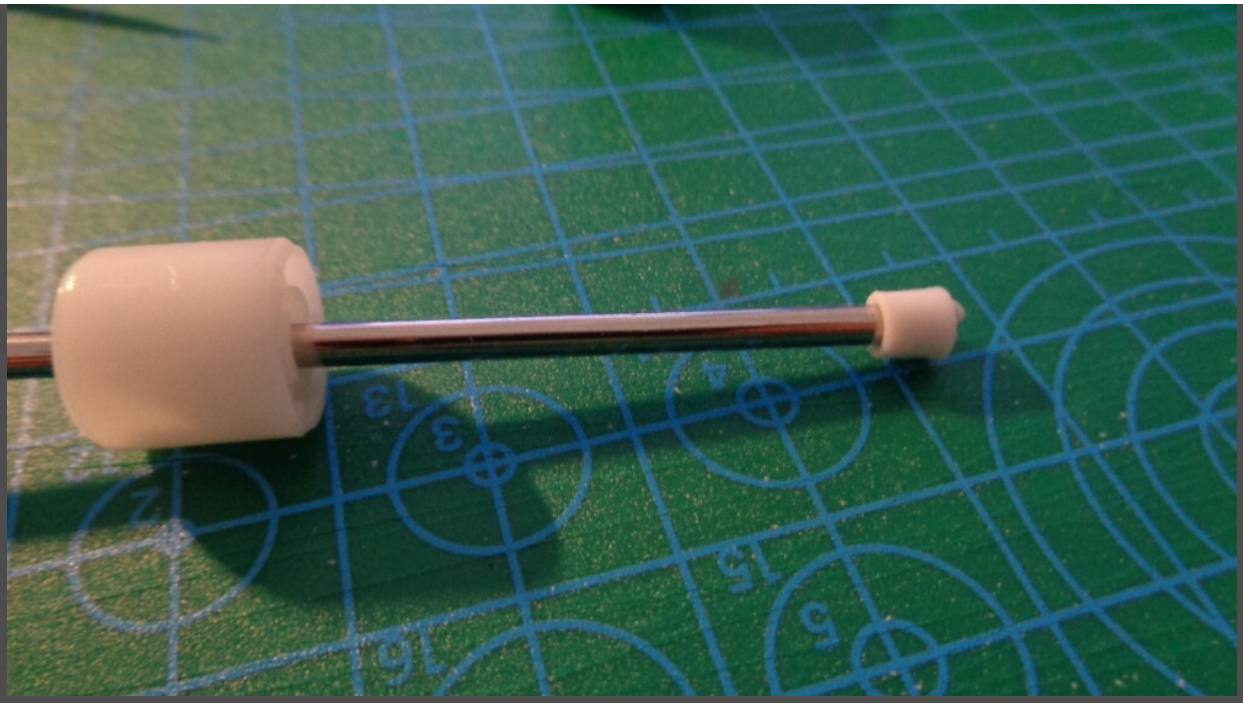
Since I spontaneously had no better idea how to get the inside diameter of the rolls out, I simply put different drill inserts into the hole and came to the result "3". So I had to file out 1.8mm. This is fortunately quite simple with plastic and does not pose any problems.



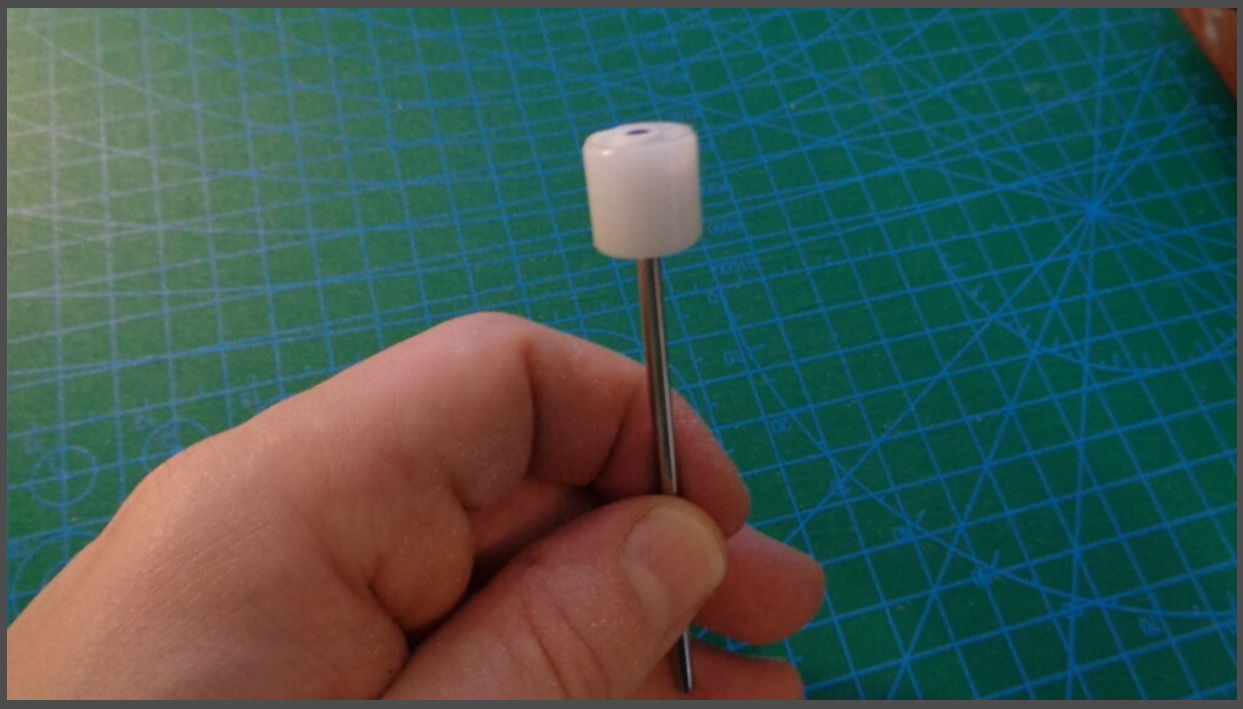
Here I have once again put the two components in front of each other for size comparison. Maybe some people already have an idea of what kind of plan I'm pursuing.

At my first attempt (see photo) I prepared the roll with a file. But that took too long, so I tried my multifunction device. It was faster, but also less clean. In the last step I used a drill with a 4 size drill insert. I hoped that the metal rod would need 0.1-02 mm more space and that I would have the right size again.

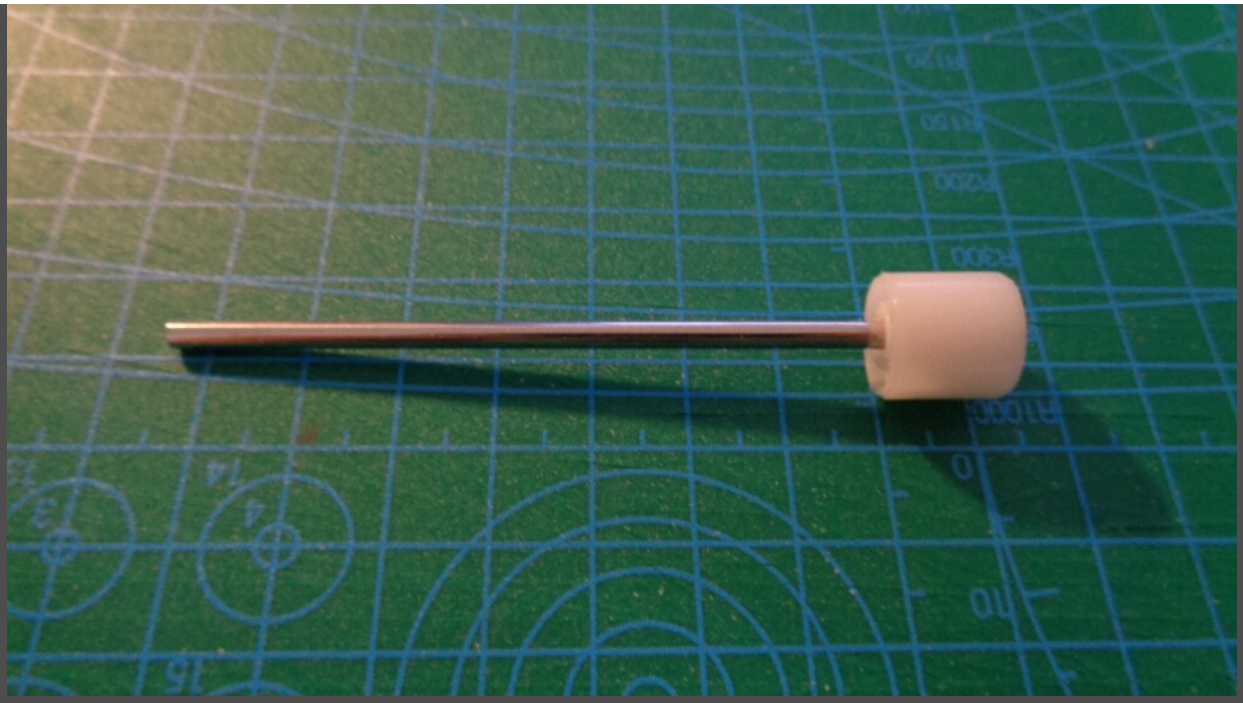
This is what the two interconnected components look like. Since roll, iron-on beds and metal rod all press against each other, no components slip. It's easier than expected and works really well.



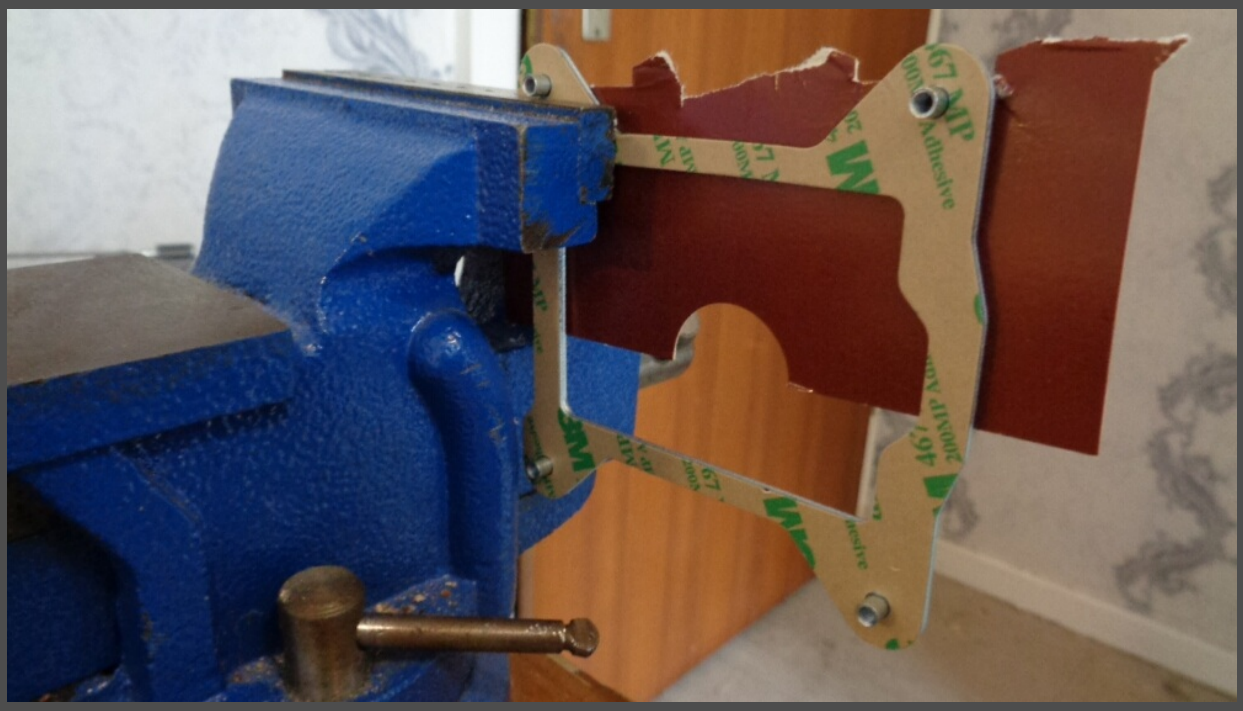
With this pole the iron-on bed has warped, because I polished out dirty (that was my first try). Ma can see exactly how the iron-on bed takes on the other form. I have to test if the beds can be soldered together, maybe with a hot air device.



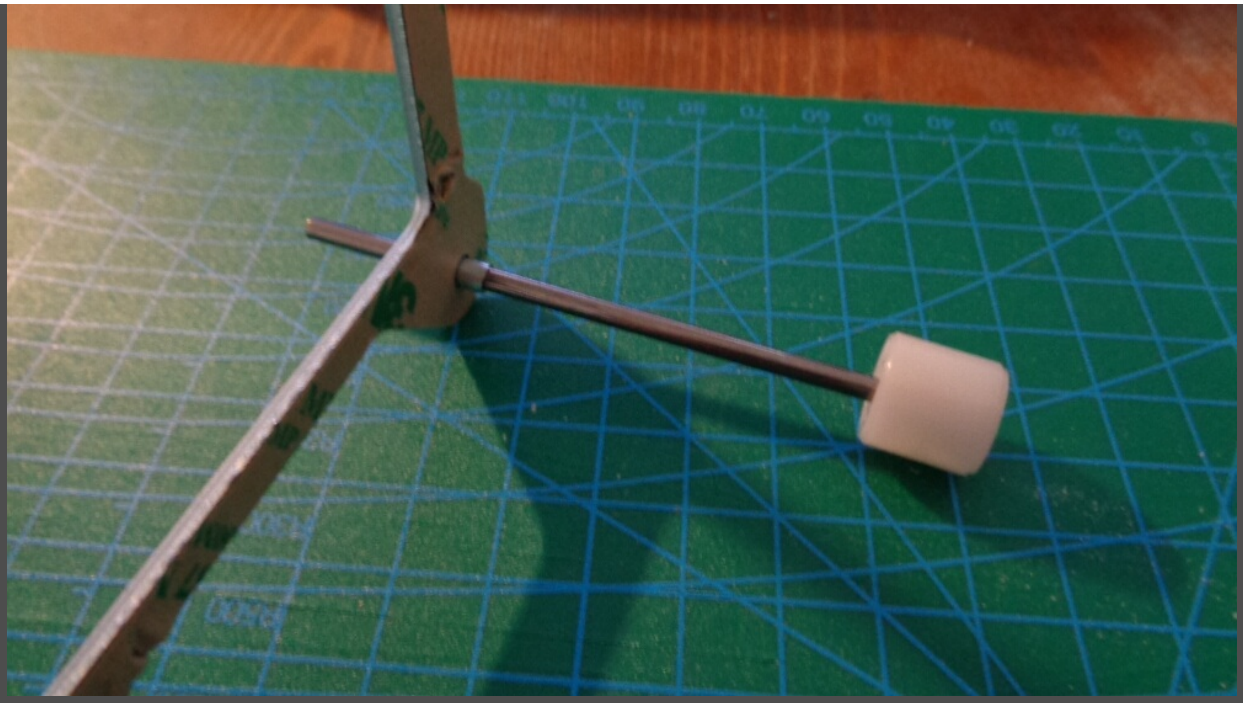
The deformation is no longer visible from the outside and since this is a *let's show* prototype, it is not at the top of the list of priorities. It has to look good and show the technical weaknesses. So e.g. these questions should be answered. "Can it hold at all with the small rolls or does it wobble too much?", "Can you connect components to one another without adhesives, so that they hold even if you use them more often?" or "Does the design fit with a microscope?". It's about testing what's possible. So we will see later that an idea was not so good and was exchanged.



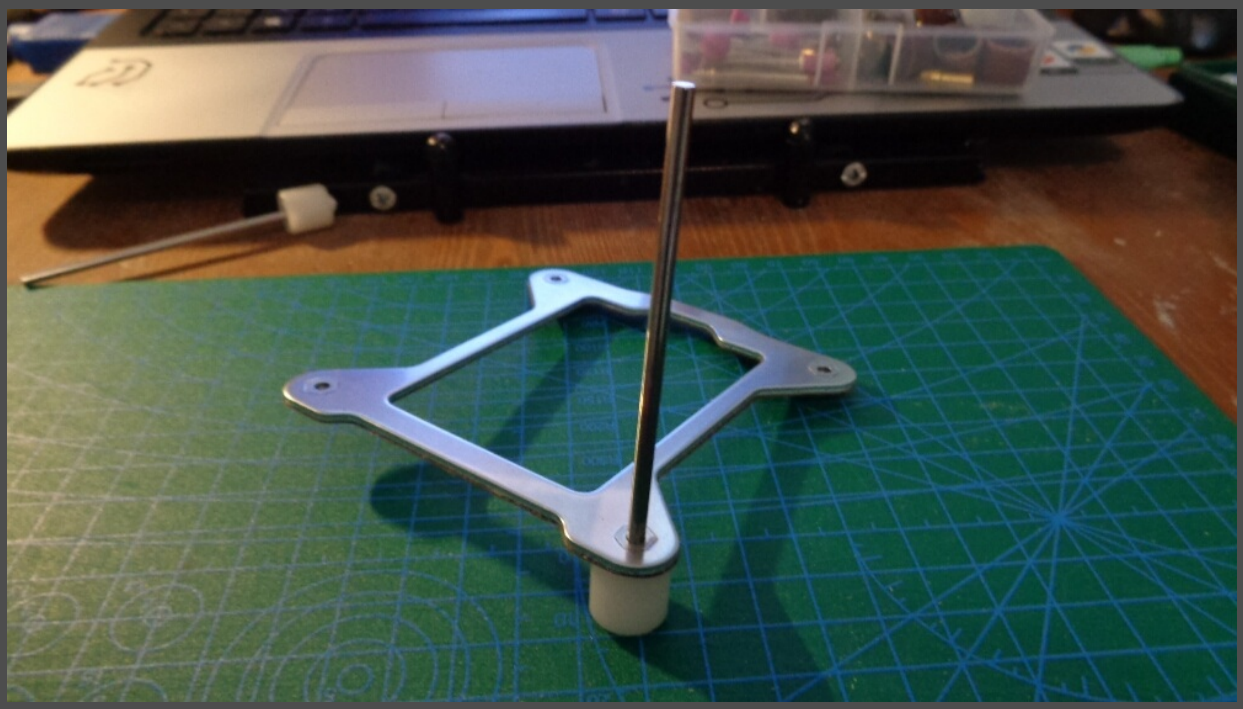
Here the whole construction in a side view. We need four of them so that our base can stand safely.



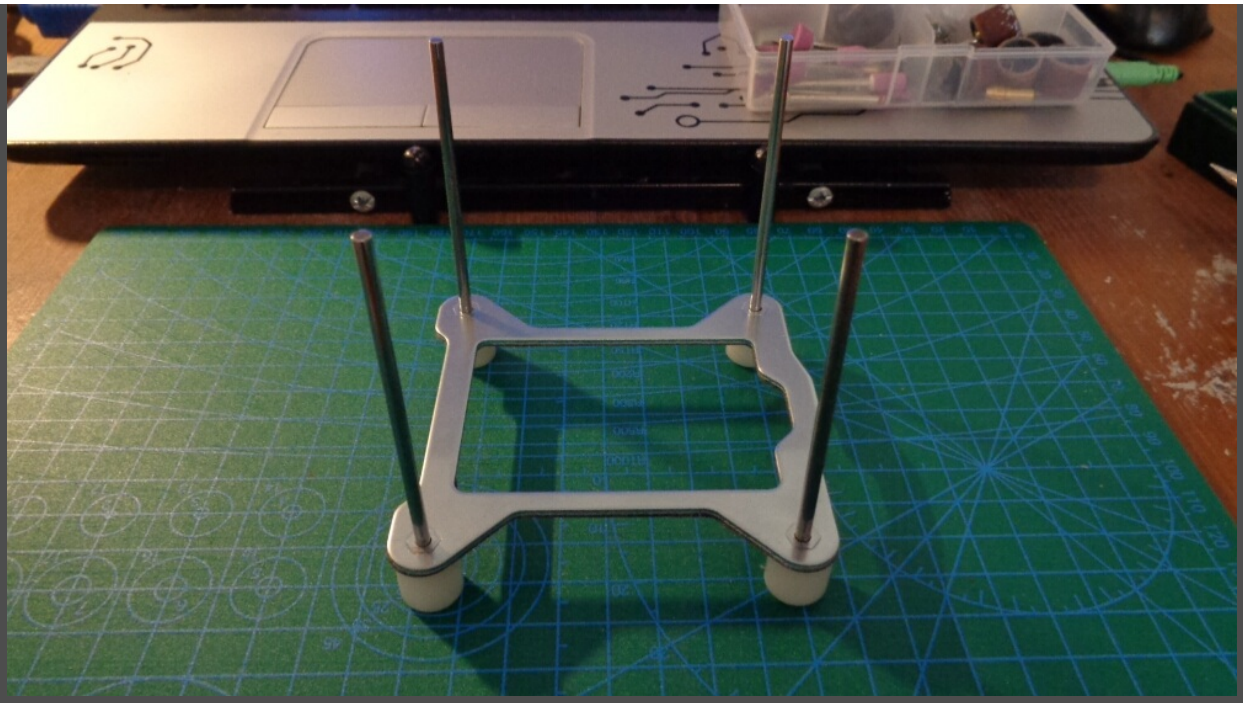
When inserting the metal rod I noticed that the small tube inside the frame still has a thread. I had to drill it out with a metal drill bit. I clamped the workpiece in a parallel vice. I clamped the cardboard on one side to prevent the vice from scratching the metal. So I can clamp the frame tighter and don't slip off by mistake with the drill.



The rod fits incredibly well into the hole and is very easy to remove. You rarely have such suitable components at hand or have to search for them in your boxes for much longer.



Here I have already put the frame around properly and you can already see that everything fits.

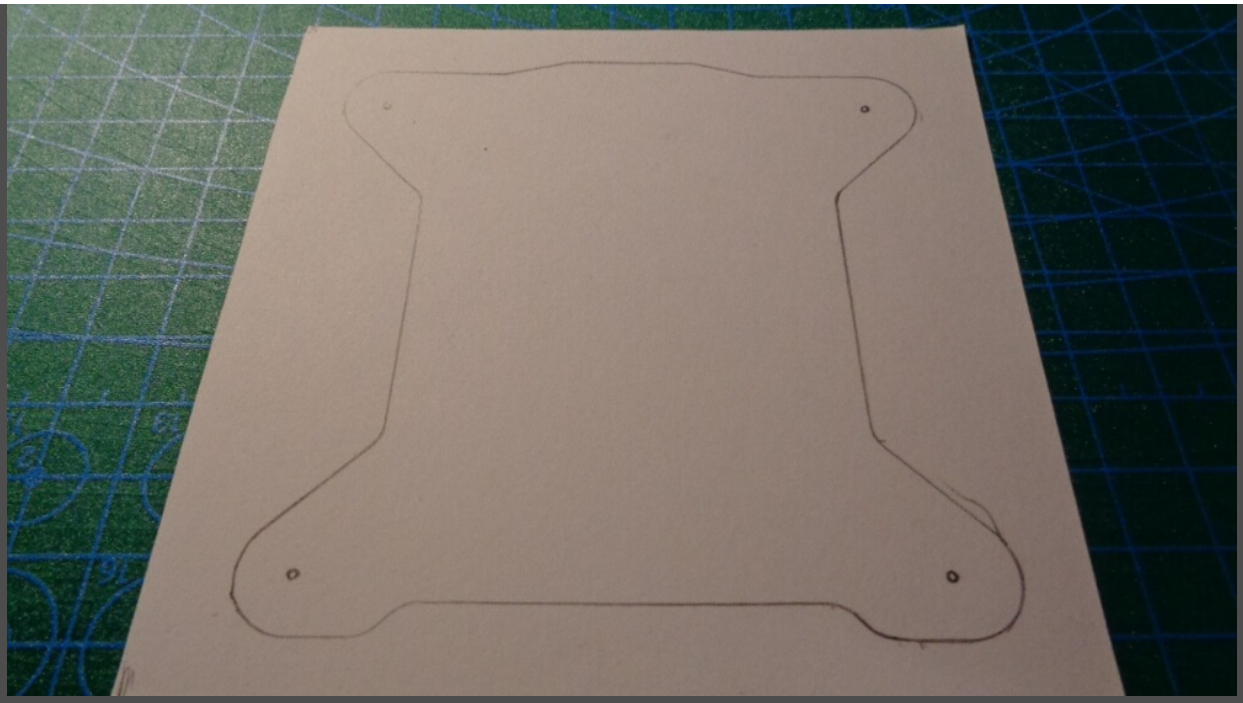


Here we see that everything fits together perfectly. But since I already have some experience with my projects, I often leave them on my desk for a night. Shortly before falling asleep, I let all work steps run in my mind's eye. I noticed that it's rather bad with a frame if you want to build a microscope. It is better to use a different base. Also with another color, so that e.g. PCB's, insects or seeds stand out better from the background. I had to revise my first idea and find a better solution.

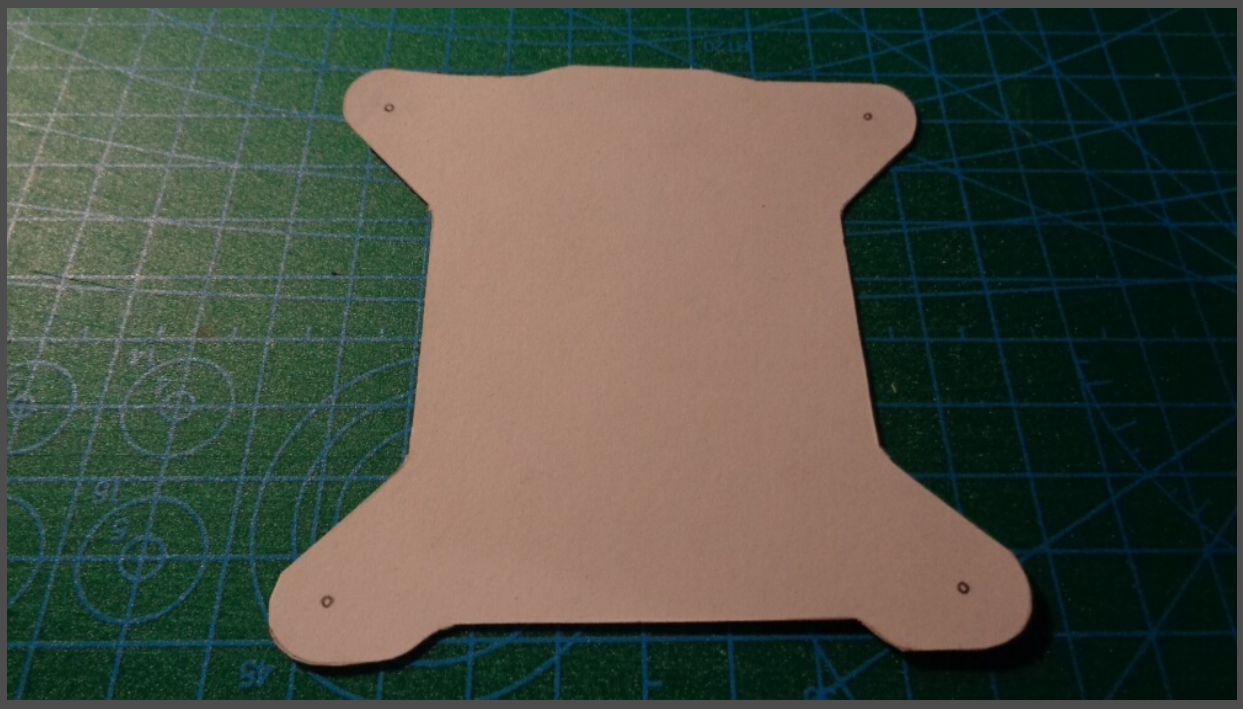
A new Base

Sometimes it is better to first create a paper model to implement an idea. You are on the safe side and save expensive material, if something should not look as good as you imagined. For most of my projects I use white cardboard (160 g/m²) which doesn't cost much and is available in a well-assorted paper shop. Cardboard is also strong enough to be used as a professional case. To create a very simple model, we take all the poles out of the metal frame and place them on the cardboard as a template.

With a sharp pencil we trace the contour of the frame.

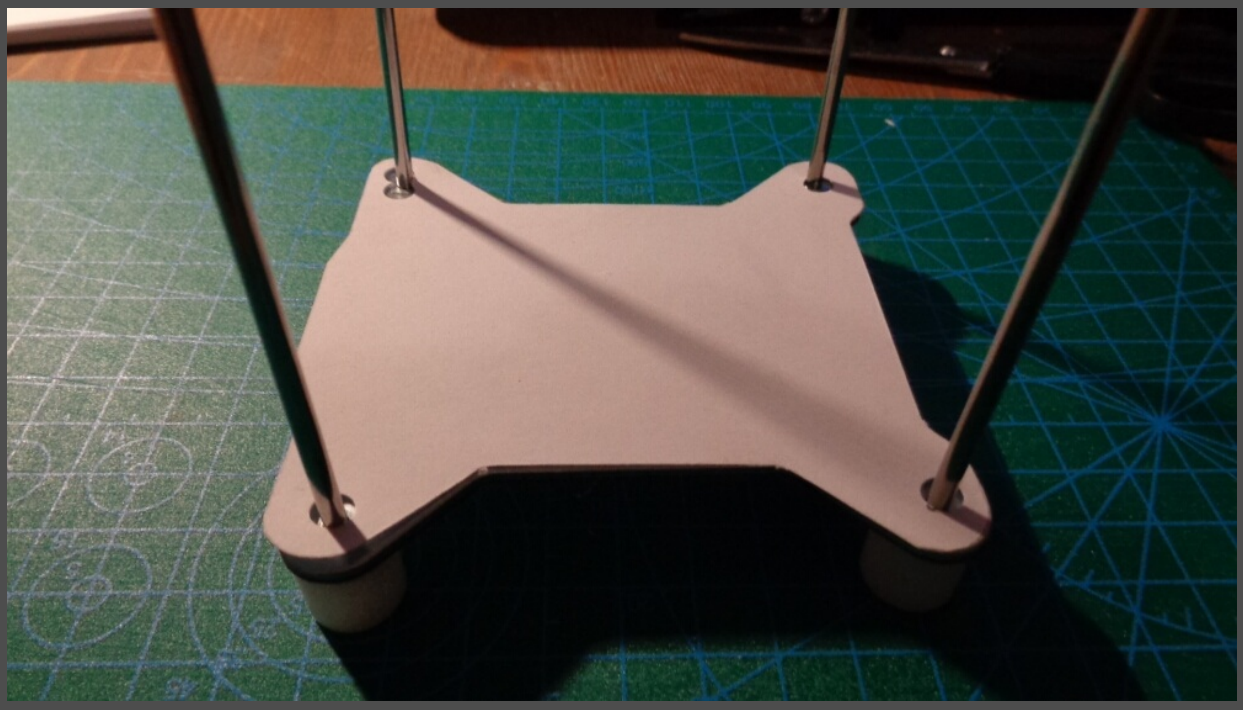


When we have completely recorded the frame, we cut it out with a model knife and a metal ruler. If necessary, we can also use scissors, but you can't work so cleanly with them. I also need a tool to cut out circles better, but I haven't found anything good yet.

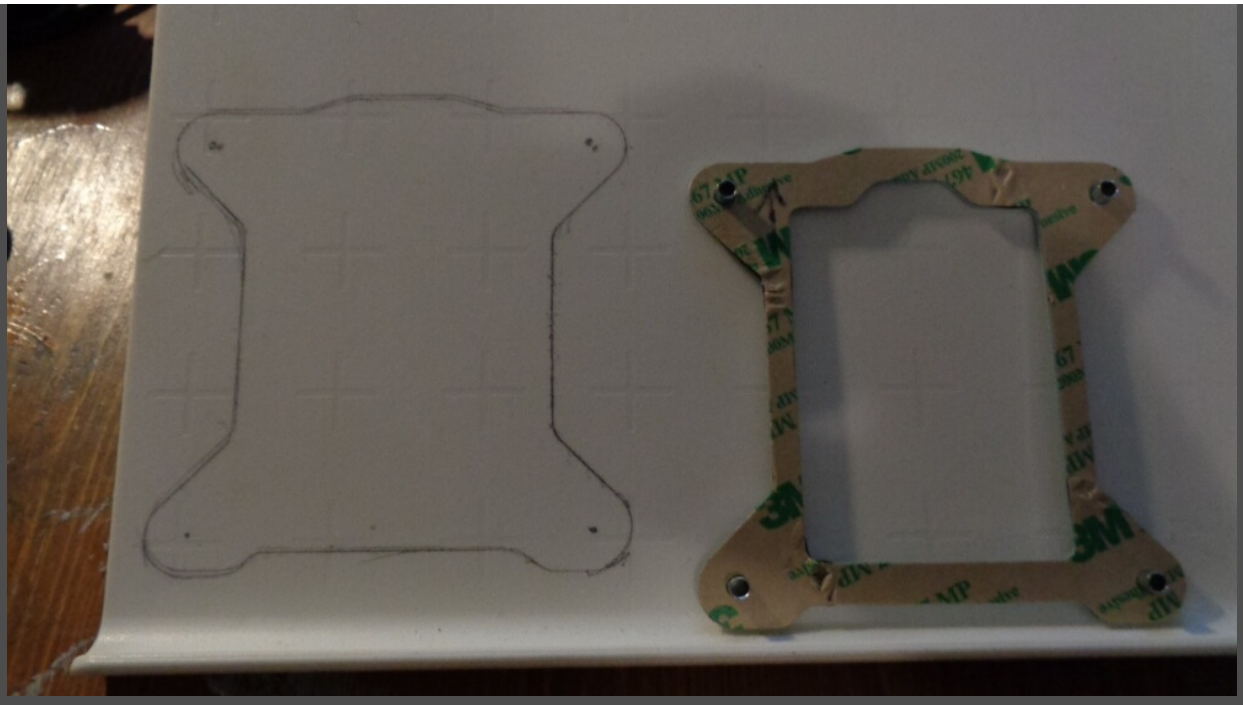


I made the holes for the rods with a paper punch. It's a bit difficult to determine the exact position, but you can ignore that because it's only enough for a short test.

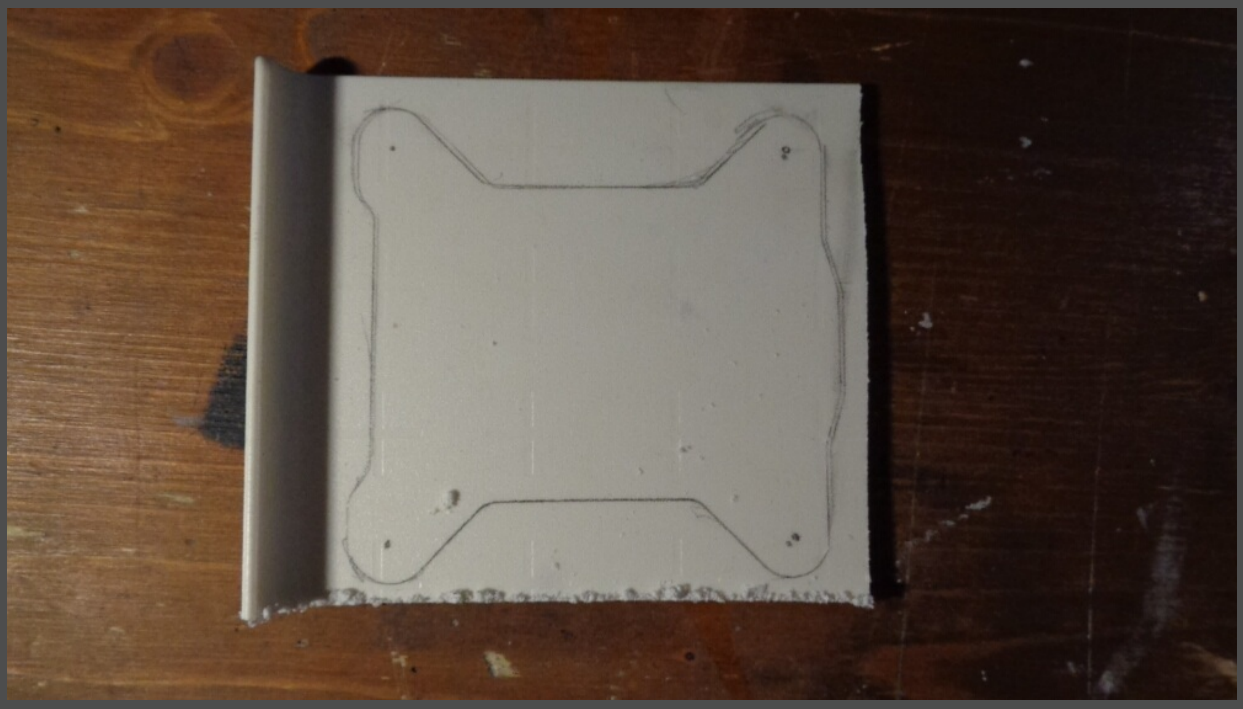
Since the cardboard is not strong enough to hold the four rods, I used the metal frame again. It was exactly what I had imagined. Now all I had to do was find a white material (preferably plastic) that I could process easily. By chance I had a quick solution. A few weeks ago a cheap laptop stand made of plastic broke down. I had stored it in a box for broken materials.



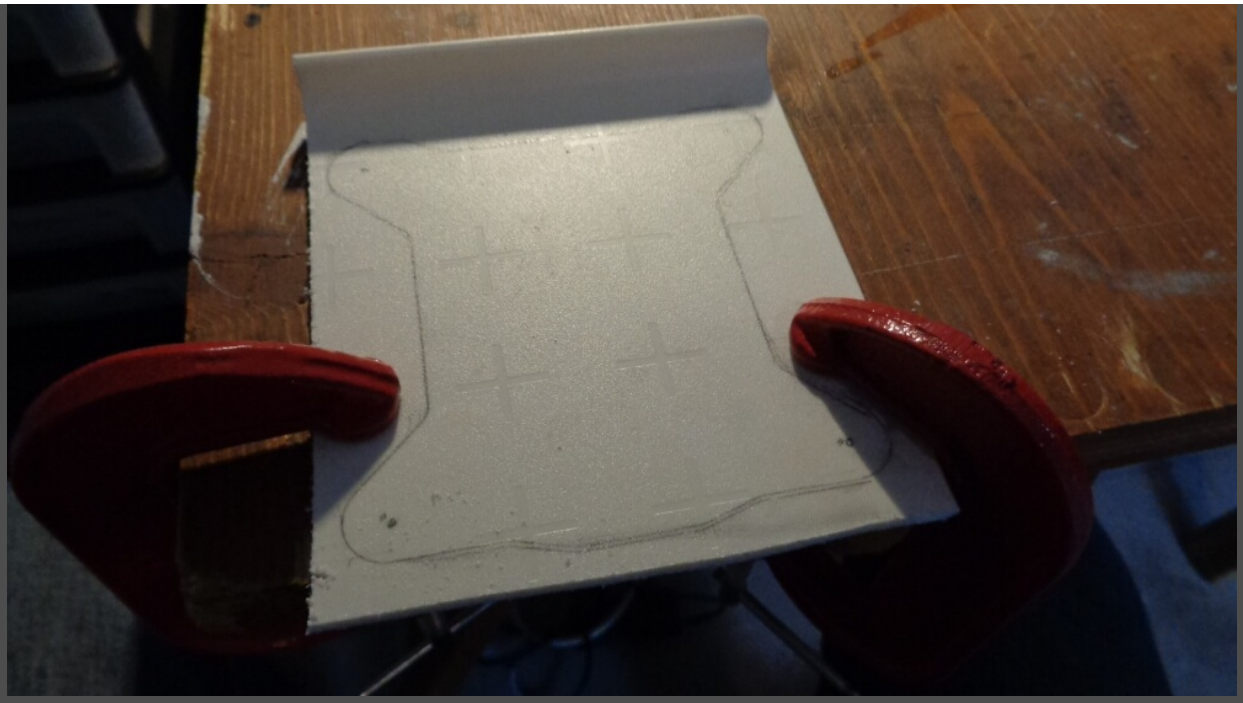
As with paper, we can simply transfer the outline onto the plastic. Normally I use a CD marker or another pen with permanent paint. Fortunately I could use my pencil.



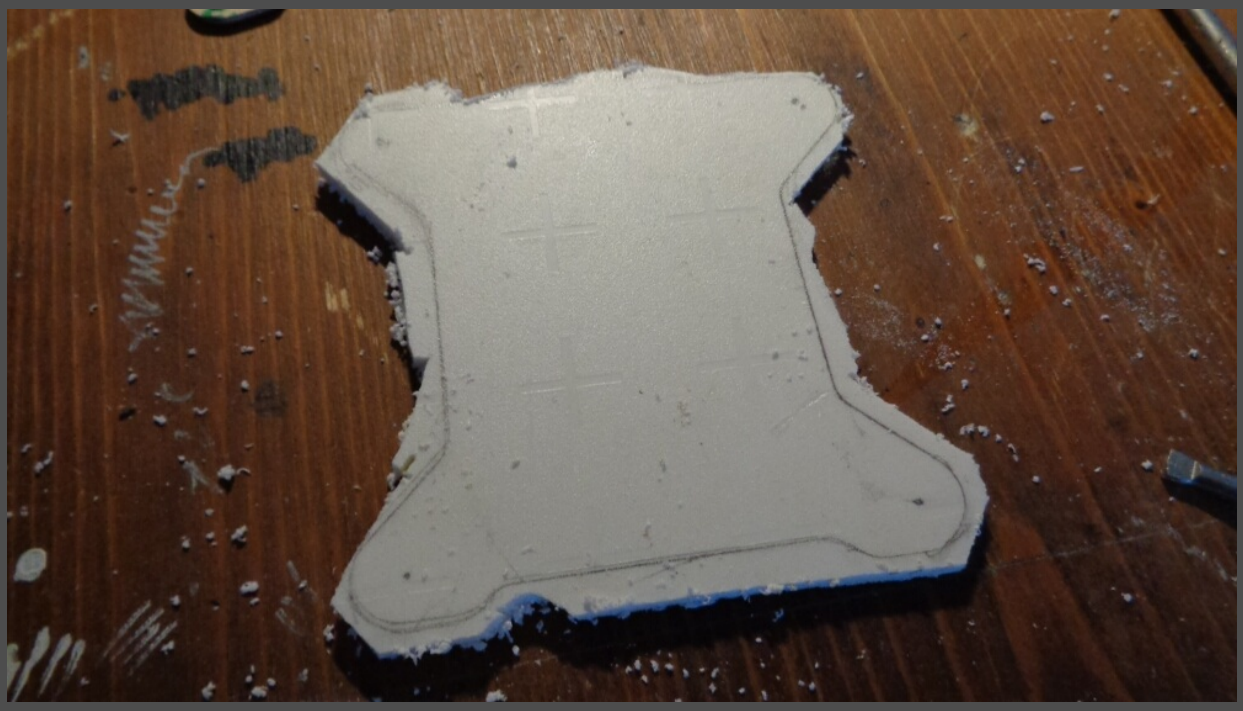
After we have drawn the pattern, we saw out the pattern roughly. I used a metal saw that worked best. Of course you can also try other saws. Since there are different types of plastic, I can't give an exact estimate now, but only speak for my application case.



So that I can saw better, I fixed the plastic to my work table with screw clamps. This prevents me from slipping and from accidentally cutting into my hand. It also helps to work more precisely.



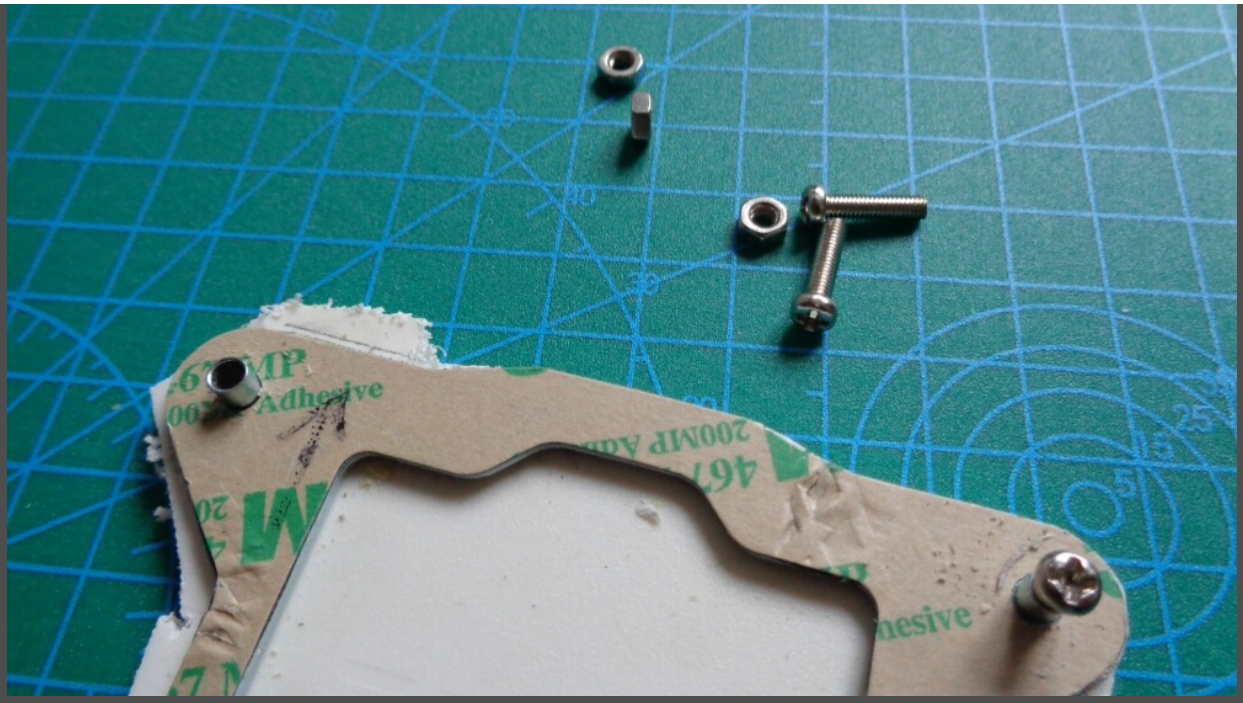
A tip I've learned over the years. It is better not to saw out everything perfectly immediately, but to approach the drawn line. With many small steps you reach your goal better.



The technique on the next pictures I taught myself also by several failed attempts. We tighten the metal frame with the plastic on a wooden base. This should not be your table, because we have to drill through the plastic.

Here I drill the holes, into which our metal rods will be inserted later. With plastic I always use a wood drill.

After I had drilled the holes, I looked for all screws with nuts from my tool case and screwed the metal frame with the plastic. This way you can saw cleanly and you don't cut yourself, because the metal protects the plastic. A very simple trick, but it has a big effect.

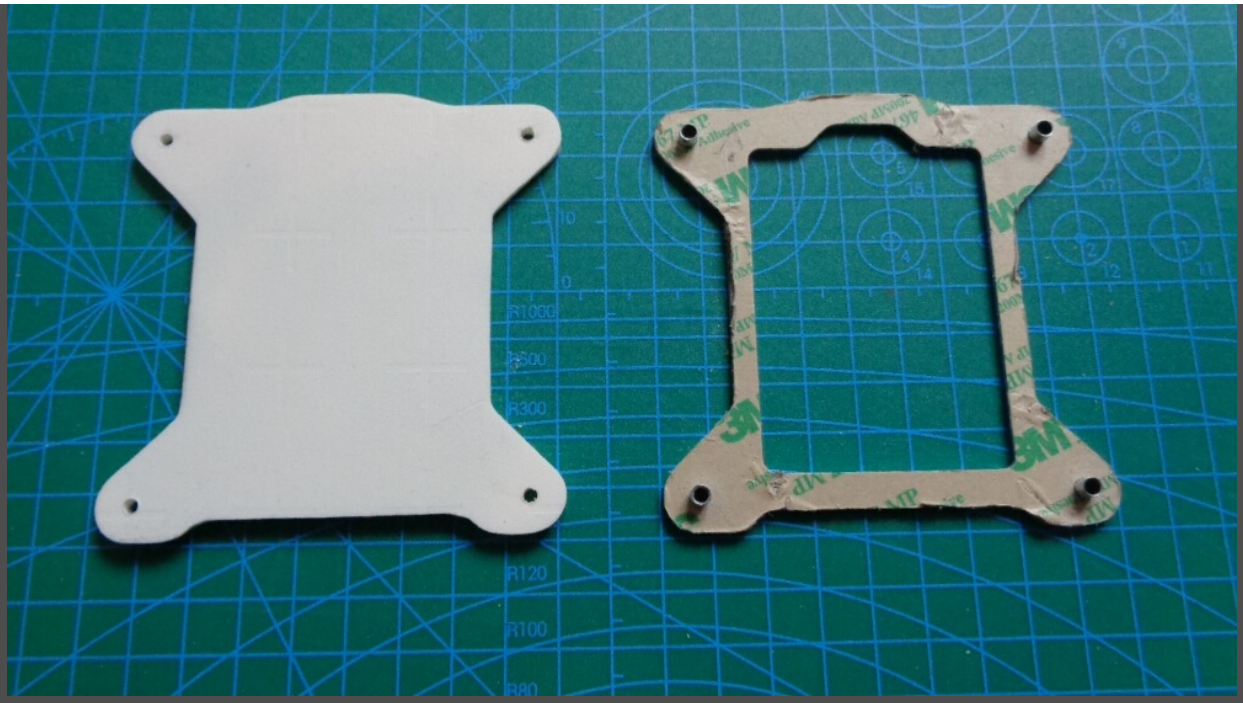


Here you can see in a side view how I inserted the screws.

Since it was a very soft plastic I could continue after sawing with the carpet knife. With it you can work very clean and the cut surface becomes straight. So you don't have to grind so much later and you save a little time at work.

Normally I always use sandpaper with a block of wood, but this time I tried something different. In the drug store I bought files for little money, which are actually used for the fingernails. These are very good for working accurately and curves are not as difficult as before. I will use them more often in the future, because I made very good experiences with this project with it.

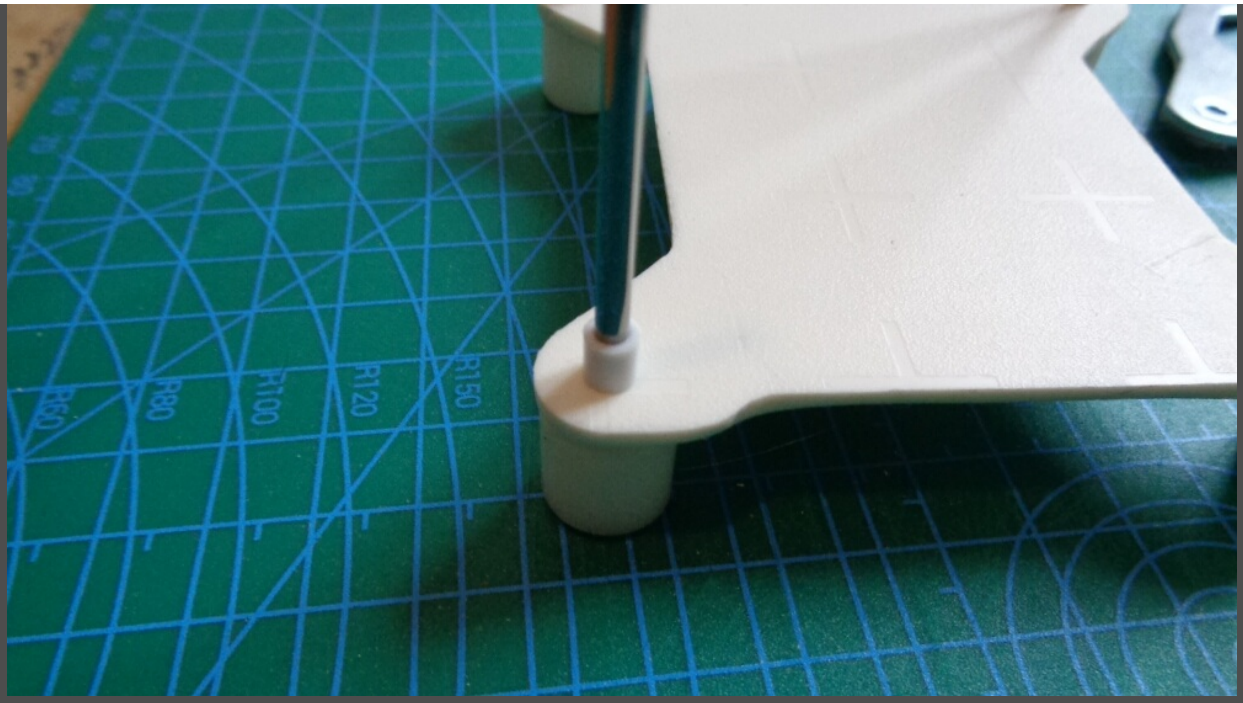
Here you can see the metal frame and the copy next to each other. Of course I am not satisfied with the result, because it is too inaccurate for me. I have very high demands on my own work and always have to hold myself back with a prototype, because otherwise I lose myself in details. Here's another tip. Don't put too much work into an idea, leave perfection to the machines. A CNC miller/laser will always be able to do this better and if you don't have any machines of your own, just check the internet. There are hundreds of suppliers offering these services. I have done this myself so far and wasted too much important time. Therefore I will use this project to test a service provider. Of course I will report about it in my next articles.



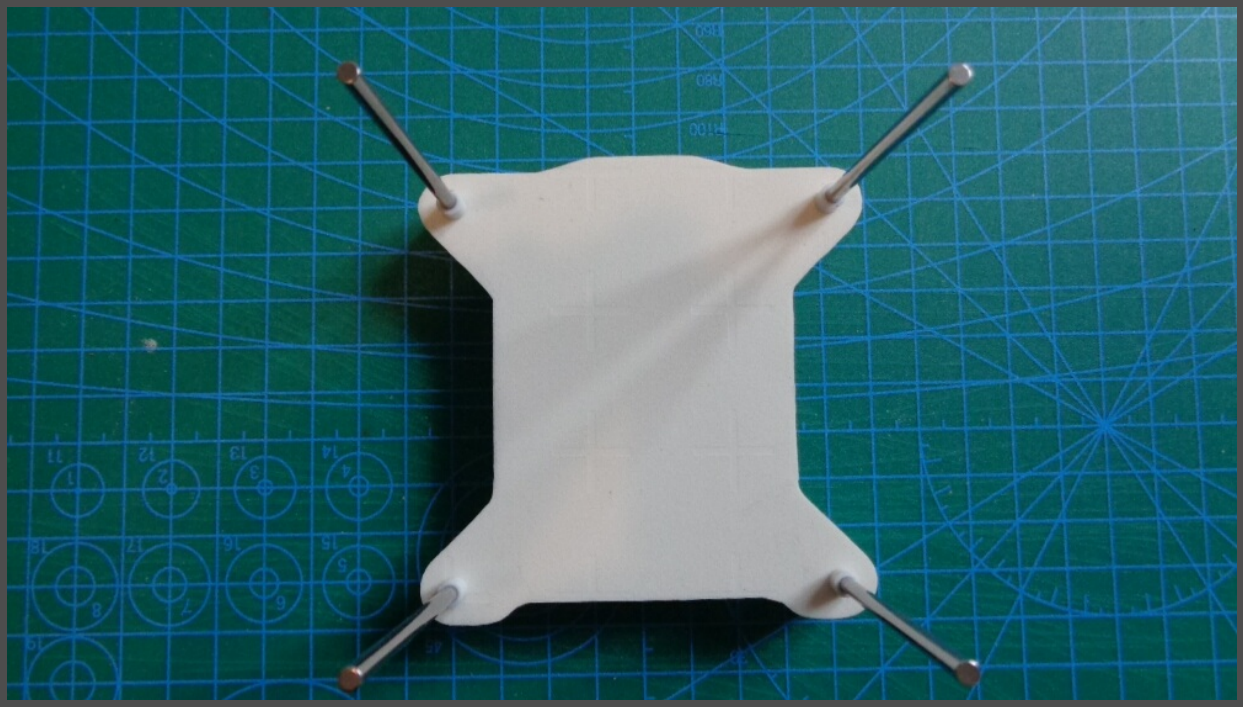
Here I use the drill holes so that I can push the metal rods better into the plastic. If you can't do it by hand you can do it carefully with a hammer.

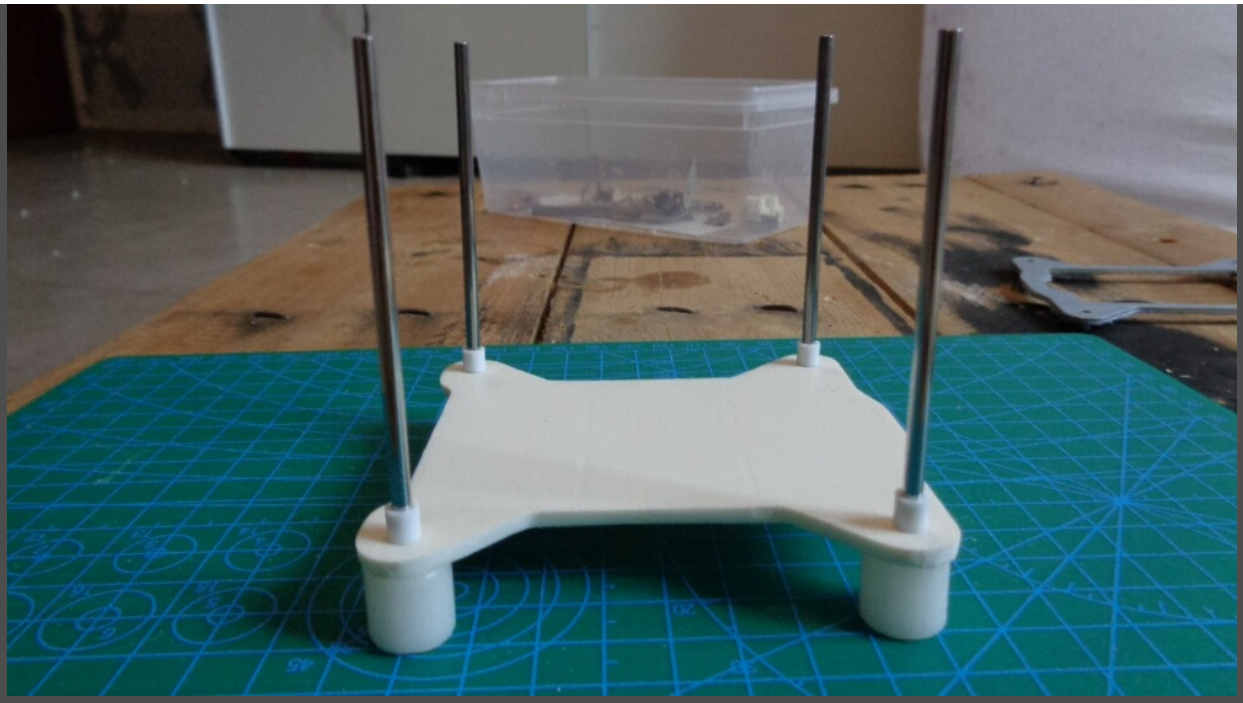
Here I inserted the first pole and everything fits perfectly.

To secure the bar, I used an iron-on bed again. At this point you can also see that the edge of the plastic has not become perfectly straight.



From the top the whole construction looks great and I am approaching a real prototype. This also shows that you can work professionally with very few purchased materials. But I must honestly admit that this has a lot to do with experience and many failed projects. So you don't have to be annoyed if it doesn't work the first time. The best approach is to implement and practice a lot of ideas.



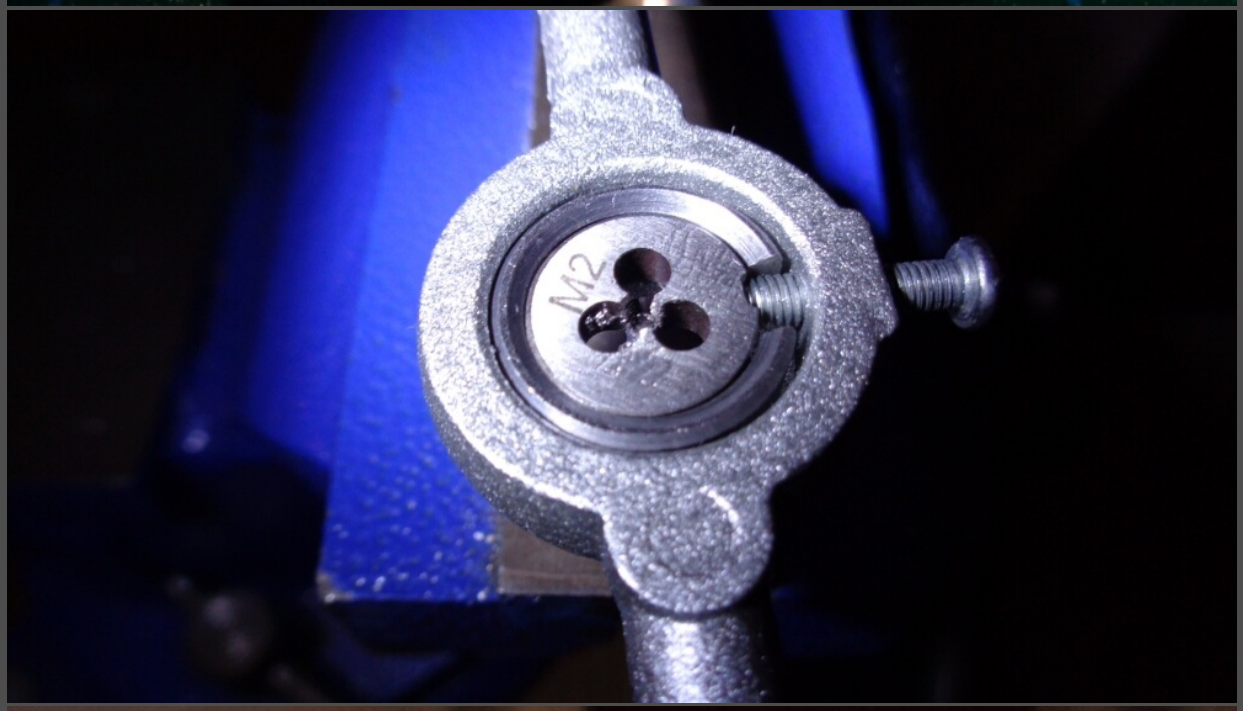


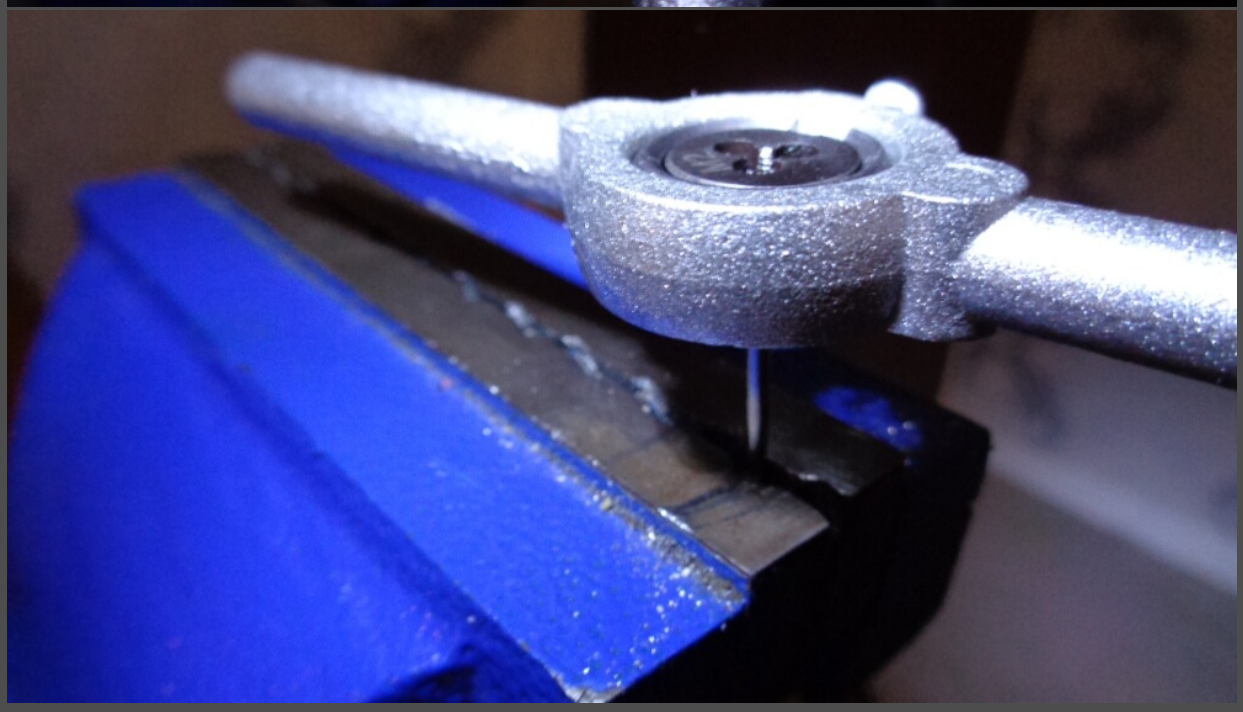
Even though I'm not quite satisfied with some details yet, the base still looks quite good. Now we have to take care of the lens from the microscope in the next section. All in all, everything is going in the right direction.

Microscope Lens Base

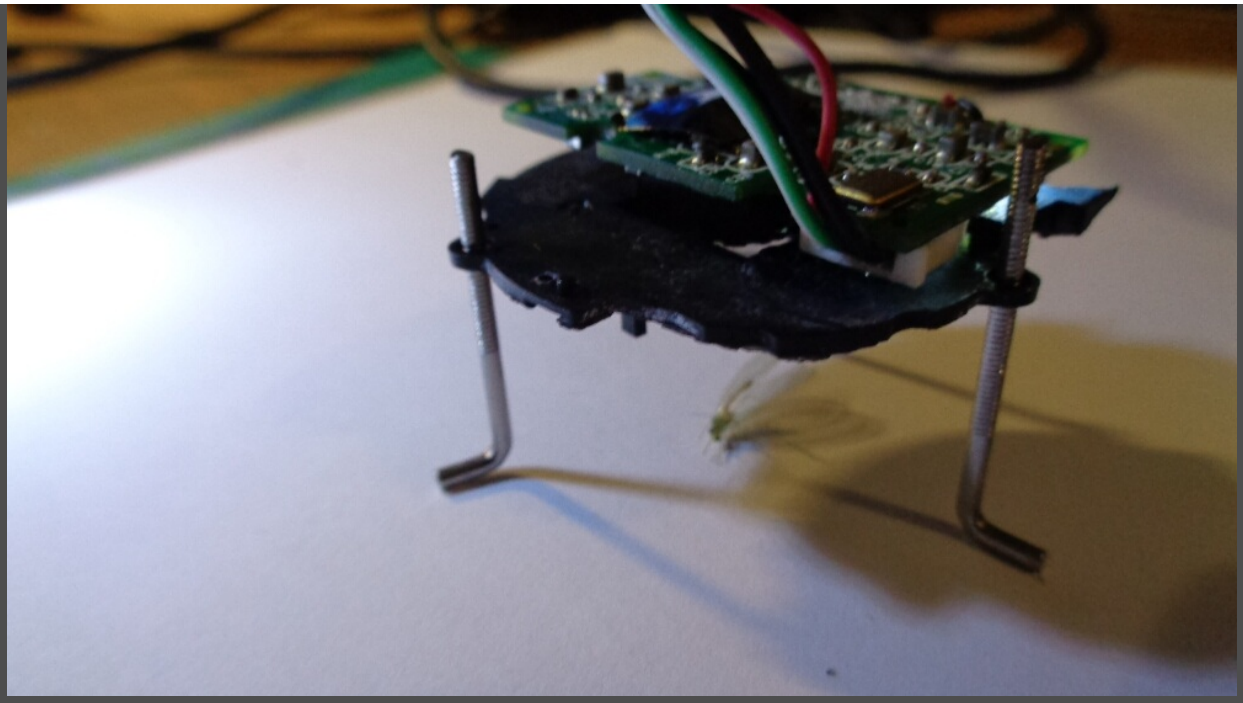
Since I will use a new lens in the next versions, I didn't want to invest so much time and material here anymore. I took three small curved rods and tapped them. With this you could screw them into the small holes in the plastic. This is a good method if you don't want to use glue. Before, the outer diameter of the metal bar was as wide as the inner diameter of the plastic. But with the new thread we can screw in the *screw*, because plastic is softer than metal and is therefore reshaped.

I will write a more detailed article on the topic of threading tools in another place, which also contains better photos where you can see more details.





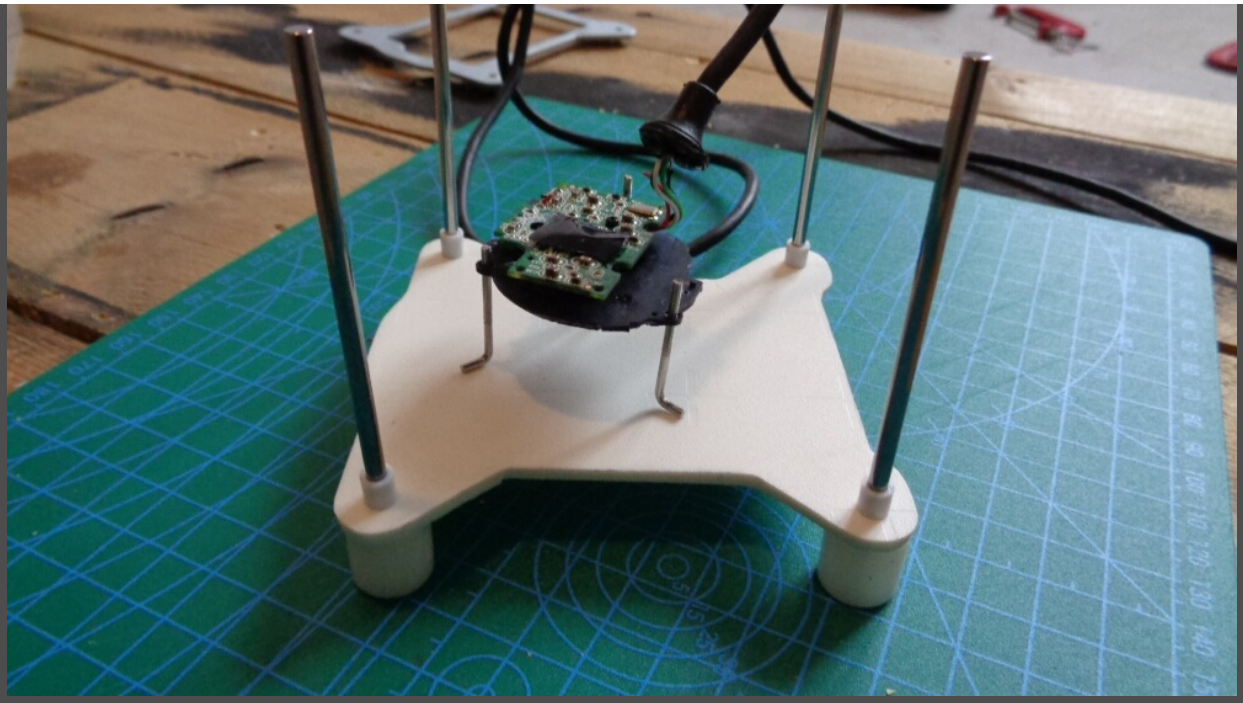
Here you can see how I test the little feet with the lens.



USB Microscope Test

I noticed that elementary os' own webcam software records the images mirror-inverted, so I used "cheesy webcam booth". But I don't like the size of the pictures, which I would like to convert to 1000 x 562 px. I will also look here for a suitable software. But since the hardware will be changed in the next versions, this will happen later. I tested one of the small feet (3mm) and a Microship on the white base.

Conclusion



Overall I am satisfied with this version. Everything could be implemented quite well, although not everything was built perfectly. But I can already say that the microscope will get a bigger update from the lens. The white base is great and makes the hardware look like a medical device. I also like the shape. It's minimalistic but not boring. Of course you could make everything rectangular and save material during production, but that would look really cheap. I also like to integrate some round elements into the construction. What bothers me a bit is that the plate is already very tightly connected to the rods. For example, if you want to change the plate quickly, don't give it that easy. Actually there should be a quick clamping system. For the next version I plan to fix hardware under the plate, but I suspect that the plate is a little too thin.